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PATENT ABSTRACTS OF JAPAN

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(54) NONAQUEOUS ELECTROLYTE SECONDARY BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a nonaqueous electrolyte secondary battery on which a high temperature preserving characteristic after charging is improved by containing one or more kinds of phosphoric ester, halogen-containing phosphoric ester and condensation phosphoric ester in nonaqueous electrolyte containing lithium salt.

SOLUTION: In a nonaqueous electrolyte secondary battery having chargeable- dischargeable positive and negative electrodes and nonaqueous electrolyte containing lithium salt, phosphoric ester such as triphenylphosphate, halogen- containing phosphoric ester such as trichloroethylphosphate, condensation phosphoric ester such as aromatic condensation phosphoric ester or the like are contained by 0.1 to 20wt.% in this nonaqueous electrolyte, and thermal stability is attained without impairing ion conductivity or the like. It is also desirable that a mix of the negative electrode contains polyphosphate by 0.1 to 20%. It is desirable, that a mix of the positive electrode contains an alkaline earth metal hydroxide, Sb₂O₃, borate, ZrO₈, polyphosphate or the like by 0.1 to 20%.

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CLAIMS

[Claim(s)]

[Claim 1] The nonaqueous electrolyte rechargeable battery characterized by containing at least one chosen from the group which the positive electrode in which charge and discharge are possible, the nonaqueous electrolyte containing lithium salt, and the negative electrode in which charge and discharge are possible are provided, and the aforementioned nonaqueous electrolyte becomes from phosphoric ester, ** halogen system phosphoric ester, and condensation phosphoric ester.

[Claim 2] The nonaqueous electrolyte rechargeable battery characterized by providing the positive electrode in which charge and discharge are possible, the nonaqueous electrolyte containing lithium salt, and the negative electrode in which charge and discharge are possible, and the mixture of the aforementioned negative electrode containing a polyphosphate.

[Claim 3] The nonaqueous electrolyte rechargeable battery characterized by containing at least one chosen from the group which the positive electrode in which charge and discharge are possible, the nonaqueous electrolyte containing lithium salt, and the negative electrode in which charge and discharge are possible are provided, and the mixture of the aforementioned positive electrode becomes from the polyphosphate of an alkaline-earth-metal hydroxide, an antimony oxide, a borate, a metaboric acid salt, a zirconium oxide, a type metal, or a semimetal, and the polyphosphate containing ammonia.

[Claim 4] The nonaqueous electrolyte rechargeable battery according to claim 1 which is at least one chosen from the group which the aforementioned phosphoric ester becomes from triphenyl phosphate, tricresyl phosphate, trixylenyl phosphate, cresyl diphenyl phosphate, xylenyl diphenyl phosphate, 2-ethylhexyl diphenyl phosphate, dimethyl methyl phosphate, and triaryl phosphate.

[Claim 5] ***** halogen system phosphoric ester is tris chloro ethyl phosphate, tris dichloro propyl phosphate, tris-beta-chloropropyl phosphate, tris (TORIBUROMO phenyl) phosphate, tris (TORIBUROMO neopentyl) phosphate, and a diethyl. - Nonaqueous electrolyte rechargeable battery according to claim 1 which is at least one chosen from the group which consists of N and N-screw (2-hydroxyethyl) aminomethyl phosphate.

[Claim 6] The nonaqueous electrolyte rechargeable battery according to claim 1 whose aforementioned condensation phosphoric ester is at least one of aromatic condensation phosphoric ester and the ** halogen system condensation phosphoric ester.

[Claim 7] The nonaqueous electrolyte rechargeable battery according to claim 2 which is at least one chosen from the group which the aforementioned polyphosphate becomes from the polyphosphate of a metal or a semimetal, the polyphosphate containing ammonium, and poly chloro phosphite.

[Claim 8] The nonaqueous electrolyte rechargeable battery according to claim 3 which is at least one chosen from the group which the aforementioned alkaline-earth-metal hydroxide becomes from a calcium hydroxide, a barium hydroxide, a magnesium hydroxide, and a strontium hydroxide.

[Claim 9] The nonaqueous electrolyte rechargeable battery according to claim 3 whose aforementioned antimony oxide is at least one of an antimony trioxide and the antimony pentoxide.

[Claim 10] The nonaqueous electrolyte rechargeable battery according to claim 3 whose aforementioned metaboric acid salt is at least one of the metaboric acid salts containing the metaboric acid salt and ammonium of a metal or a semimetal.

[Claim 11] The nonaqueous electrolyte rechargeable battery according to claim 1 which contains at least one chosen from the group which the aforementioned nonaqueous electrolyte becomes from phosphoric ester, ** halogen system phosphoric ester, and condensation phosphoric ester at a 0.1 - 20wt% rate.

[Claim 12] The nonaqueous electrolyte rechargeable battery according to claim 2 with which the mixture of the aforementioned negative electrode contains the polyphosphate at a 0.1 - 20wt% rate.

[Claim 13] The nonaqueous electrolyte rechargeable battery according to claim 3 which contains at least one chosen from the group which the mixture of the aforementioned positive electrode becomes from the polyphosphate of an alkaline-earth-metal hydroxide, an antimony oxide, a borate, a metaboric acid salt, a zirconium oxide, a type metal, or a semimetal, and the polyphosphate containing ammonia at a 0.1 - 20wt% rate.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the nonaqueous electrolyte rechargeable battery of high-energy density.

[0002]

[Description of the Prior Art] It is expected that the nonaqueous electrolyte rechargeable battery which uses alkali metal, such as a lithium (Li) and sodium (Na), as a negative electrode has high electromotive force, and it has high-energy density compared with a conventional NIKADO battery and a conventional lead accumulator, and many researches are made. Many researches are made especially about the nonaqueous electrolyte rechargeable battery which uses a metal lithium as a negative electrode. However, since a dendrite will be generated at the time of charge and it will become easy to cause a short circuit if alkali metal is used for a negative electrode, it becomes the low cell of reliability. In order to solve this problem, using the alloy negative electrode of the lithium as an alkali metal, aluminum (aluminum), and lead (Pb) was examined. If these alloy negative electrode is used, since occlusion of the lithium is carried out into a negative-electrode alloy, a dendrite will not generate it in charge. Therefore, a reliable cell can be constituted. however, the discharge potential of an alloy negative electrode -- a metal lithium -- comparing -- about -- since it is 0.5V ** -- a cell voltage -- 0.5V -- it is low and, thereby, the energy density of a cell falls. On the other hand, the research which makes the intercalation compound of carbon and lithiums, such as a graphite, a negative-electrode active material is also made, and the part is put in practical use with the tradename of a rechargeable lithium-ion battery.

[0003] In this compound negative electrode, a lithium enters between carbonaceous layers by charge, and a dendrite is not generated. And since a discharge potential is about 0.1v ** compared with a metal lithium, its fall of a cell voltage is also small. Therefore, although it could be called the more desirable negative electrode, in the case of the graphite, that a lithium puts in between carbonaceous layers by charge had theoretically the problem of being C6Li, with the highest value. The electric capacity in this case is 372 Ah/kg. Then, crystalline low carbon is proposed rather than a graphite as a negative-electrode material of the high capacity exceeding the above-mentioned theoretical value, and many researches are made. Moreover, various alloy metallurgy group oxides etc. are proposed one after another.

[0004]

[Problem(s) to be Solved by the Invention] The appearance of the various alloy metallurgy group oxides which are graphite material and a high capacity material exceeding a carbon material will realize the nonaqueous electrolyte rechargeable battery service capacity excelled [rechargeable battery] in the cycle property greatly. However, also compared with the former, an electrode will store quantity of electricity of per the weight or volume and many, and the problem that the elevated-temperature preservation property of the cell after charge became inadequate produced it. Then, this invention aims at offering the nonaqueous electrolyte rechargeable battery which raised the elevated-temperature preservation property.

[0005]

[Means for Solving the Problem] In view of the above-mentioned technical problem, the nonaqueous electrolyte rechargeable battery by this invention possesses the positive electrode in which charge and discharge are possible, the nonaqueous electrolyte containing lithium salt, and the negative electrode in which charge and discharge are possible, and is characterized by containing at least one chosen from the group which the aforementioned nonaqueous electrolyte becomes from phosphoric ester, ** halogen system phosphoric ester, and condensation phosphoric ester. Moreover, the mixture of the aforementioned negative electrode is characterized by containing a polyphosphate. Furthermore, it is characterized by containing at least one chosen from the group which the mixture of the aforementioned positive

electrode becomes from the polyphosphate of an alkaline-earth-metal hydroxide, an antimony oxide, a borate, a metaboric acid salt, a zirconium oxide, a type metal, or a semimetal, and the polyphosphate containing ammonia.

[0006]

[Embodiments of the Invention] Each of polyphosphates of phosphoric ester which was described above, ** halogen system phosphoric ester, condensation phosphoric ester, a polyphosphate, an alkaline-earth-metal hydroxide, an antimony oxide, a borate, a metaboric acid salt, a zirconium oxide, a type metal, or a semimetal, and polyphosphates containing ammonia has high thermal stability ability. Therefore, the cell which added and produced phosphoric ester, ** halogen system phosphoric ester, or condensation phosphoric ester to nonaqueous electrolyte is very stable to elevated-temperature preservation. It is desirable to use triphenyl phosphate, tricresyl phosphate, trixylenyl phosphate, cresyl diphenyl phosphate, xylenyl diphenyl phosphate, 2-ethylhexyl diphenyl phosphate, dimethyl methyl phosphate, triaryl phosphate, etc. for such phosphoric ester. In ** halogen system phosphoric ester, they are tris chloro ethyl phosphate, tris dichloro propyl phosphate, tris-beta-chloropropyl phosphate, tris (TORIBUROMO phenyl) phosphate, tris (TORIBUROMO neopentyl) phosphate, and a diethyl. - N and N-screw (2-hydroxyethyl) aminomethyl phosphate etc. can be used.

[0007] Furthermore, aromatic condensation phosphoric ester, ** halogen system condensation phosphoric ester, etc. can be used for condensation phosphoric ester. Moreover, as for these phosphoric ester, ** halogen system phosphoric ester, and condensation phosphoric ester, it is desirable to add so that it may contain at a 0.1 - 20wt% rate in nonaqueous electrolyte. When there are few contents than 0.1wt%, the heat stabilization effect cannot fully demonstrate. Moreover, since the performance of original, such as the ionic conduction nature of nonaqueous electrolyte, will be spoiled when there are more contents than 20wt(s)%, an elevated-temperature preservation property falls.

[0008] As a negative electrode in which charge and discharge are possible, carbon, the various alloys which make aluminum-Li the start, a metal lithium, a metallic oxide, etc. can be used. the negative electrode which contains a stable polyphosphate to elevated-temperature preservation in these -- if a mixture is applied, a negative electrode is produced and a cell is constituted, a very stable cell can be obtained to elevated-temperature preservation this polyphosphate -- a negative electrode -- a mixture -- the 0.1 - 20wt% thing which it comes out comparatively, and is added to inside so that it may contain is desirable There are an ammonium polyphosphate, polyphosphoric acid magnesium, polyphosphoric acid barium, polyphosphoric acid zinc, polyphosphoric acid nickel, polyphosphoric acid aluminum, poly chloro phosphite, etc. in such a polyphosphate.

[0009] As a positive electrode in which charge and discharge are possible, $\text{LiMn}_{1.8}\text{Co}_{0.2}\text{O}_4$, LiCoO_2 , LiNiO_2 , LiMnO_2 , LiFeO_2 and MnO_2 , V_2O_5 , etc. can be used. the positive electrode containing the polyphosphate which contains the polyphosphate or ammonia of a stable alkaline-earth-metal hydroxide, an antimony oxide, a borate, a metaboric acid salt, a zirconium oxide, a type metal, or a semimetal to elevated-temperature preservation in these -- if a mixture is applied, a positive electrode is produced and a cell is constituted, a stable cell can be obtained to elevated-temperature preservation To such an alkaline-earth-metal hydroxide, it is desirable to use an antimony trioxide or antimony pentoxide for an antimony oxide, using a calcium hydroxide, a barium hydroxide, a magnesium hydroxide, or a strontium hydroxide. Moreover, the metaboric acid salt of a metal or a semimetal or the metaboric acid salt containing ammonium is used for a metaboric acid salt. these -- a positive electrode -- a mixture -- the 0.1 - 20wt% thing which it comes out comparatively, and is added to inside so that it may contain is desirable In addition, the mixture of positive and a negative electrode consists of an additive of electric conduction material and others etc. each active material, a binder, and if needed.

[0010]

[Example] Drawing 1 is drawing of longitudinal section of the cylindrical nonaqueous electrolyte rechargeable battery by this invention. The whole is spirally wound through the latus band-like separator 3 made from microporosity polypropylene of width of face from a two-poles board between the core material attached in spot welding, the positive-electrode board 1 which has the positive-electrode lead 4 of this quality of the material, and the negative-electrode board 2 which has the negative-electrode lead 5, and the electrode object is constituted. Furthermore, the electric insulating plates 6 and 7 made from polypropylene are arranged on each upper and lower sides of the above-mentioned electrode object, it inserts in a battery case 8, and the step is formed in the upper part of a battery case 8. And nonaqueous electrolyte is poured in into ****, where the case upper part of a cell is opened wide, the charge and discharge of the first cycle are performed, and after making reaction generation gas emit, it has sealed with the obturation board 9 which has the positive-electrode terminal 10. Hereafter, a concrete example is given and this invention is explained.

[0011] <<example 1>> To 100g, styrene-butadiene-rubber 5g was mixed as a binder the carbon-powder end as a

negative-electrode active material. this negative electrode -- the petroleum solvent was added to the mixture, and it agitated enough, and considered as the paste The service capacity in the end of a carbon powder is 450mAh(s) perg. It was made to dry at 120 degrees C after applying to a copper core material, and further, it rolled out, this paste was cut, and the negative-electrode board was obtained. The weight of the carbon of the obtained negative-electrode board was 1.5g. Next, $\text{LiMn}_{1.8}\text{Co}_{0.2}\text{O}_4$ was compounded by mixing Li_2CO_3 , Mn_3O_4 , and CoCO_3 by the predetermined mole ratio, and heating at 900 degrees C. Furthermore, what classified this in 100 or less meshes was made into the positive active material. 100g of this positive active material -- receiving -- as an electric conduction agent -- the end of a carbon powder -- as 10g and a binder -- poly ethylene tetrafluoride -- 8g -- mixing -- further -- a petroleum solvent -- adding -- a positive electrode -- the paste of a mixture was obtained this positive electrode -- after applying the paste of a mixture to the core material of titanium, it was made to dry, it rolled out and the positive-electrode board was obtained The weight of the positive active material of the obtained positive-electrode board was 5g. As nonaqueous electrolyte, it mixed by specific volumes [dimethoxyethane / ethylene carbonate, dimethoxyethane etc. / which dissolved the one mol //l. / lithium perchlorate], phosphoric ester was added further, and what was fully mixed was used. Phosphoric ester was added so that it might contain at a 2wt(s)% rate in this nonaqueous electrolyte. A cell like drawing 1 was produced using the negative-electrode board, the positive-electrode board, and nonaqueous electrolyte which were obtained as mentioned above. The amount of the poured-in electrolytic solution was 2.6ml. Similarly, the cell using the nonaqueous electrolyte which added ** halogen system phosphoric ester, and the cell using the nonaqueous electrolyte which added condensation phosphoric ester instead of phosphoric ester were produced instead of phosphoric ester, respectively.

[0012] The elevated-temperature retention test of the obtained various cells was performed by the following method. By the 1mA constant current, each cell was charged to 4.2 volts in 20 degrees C, and the service capacity of 10 cycle deed and 10 cycle eye was measured for the charge and discharge which discharge to 3 volts. And after charge of 11 cycle eye finished, it saved for four weeks at 60 degrees C. It returned to 20 degrees C after preservation, and discharged to 3 volts, and the service capacity at this time (service capacity of 11 cycle eye) was measured.

Furthermore, after charging to 4.2 volts, it discharged to 3 volts and the service capacity at this time (service capacity of 12 cycle eye) was measured. It asked for the capacity maintenance factor and the capacity recovery factor from the service capacity of each obtained cell. The result is shown in Table 1. However, the capacity maintenance factor and the capacity recovery factor were computed based on the following formula.

Capacity maintenance-factor = $100 \times (\text{electric discharge quantity of electricity of electric discharge quantity of electricity} / 10 \text{ cycle eye of } 11 \text{ cycle eye})$

Capacity recovery-factor = $100 \times (\text{electric discharge quantity of electricity of electric discharge quantity of electricity} / 10 \text{ cycle eye of } 12 \text{ cycle eye})$

[0013]

[Table 1]

実施例 1		容量 維持率(%)	容量 回復率(%)
リン酸エステル	トリフェニルホスフェート	90	98
	トリクロジメチルホスフェート	90	97
	トリネシレニルホスフェート	93	97
	クレジメチルホスフェート	92	97
	キシレニルホスフェート	90	97
	2-エチルヘキシルホスフェート	92	98
	シメチルメチルホスフェート	94	98
含ハロゲン系リン酸エステル	トリスクロロエチルホスフェート	92	96
	トリスクロロプロピルホスフェート	93	96
	トリスクロロプロピルホスフェート	93	96
	トリス(トリプロピル)	92	96
	トリス(トリプロピル)	90	98
	ジエチル-N, N-ビス(2-ヒトキシエチル)	94	98
	アミノメチルホスフェート		
縮合リン酸エステル	芳香族縮合リン酸エステル	94	98
	含ハロゲン系縮合リン酸エステル	90	98
比較例 1		56	45

[0014] Example of <<comparison 1>> What was mixed as nonaqueous electrolyte by specific volumes [dimethoxyethane / ethylene carbonate, dimethoxyethane, etc. / which dissolved the one mol /l. / lithium perchlorate] was used, and also the cell was produced like the example 1, and the elevated-temperature retention test was performed. The result is united and shown in Table 1. By the cell which added phosphoric ester, ** halogen system phosphoric ester, or condensation phosphoric ester to nonaqueous electrolyte, the capacity maintenance factor and the capacity recovery factor were high, and Table 1 showed that there was an effect which suppresses a capacity fall.

[0015] <<example 2>> 5g of styrene butadiene rubber was mixed to 100g, and the polyphosphate was added to it in the end of a carbon powder it used in the example 1 at this. this negative electrode -- a mixture -- a petroleum solvent -- in addition, it agitated enough and considered as the paste a polyphosphate -- a negative electrode -- a mixture -- inside -- 2wt(s)% -- it came out comparatively, and it added so that it might contain It was made to dry at 120 degrees C after applying to a copper core material, and further, it rolled out, this paste was cut, and the negative-electrode board was obtained. The weight of the carbon of the obtained negative-electrode board was 1.5g. Nonaqueous electrolyte was mixed and obtained by specific volumes [dimethoxyethane / ethylene carbonate, dimethoxyethane, etc. / which dissolved the one mol /l. / lithium perchlorate]. Using the negative-electrode board obtained as mentioned above, nonaqueous electrolyte, and the positive-electrode board obtained in the example 1, the cell was produced like the example 1 and the elevated-temperature retention test was performed. The result is shown in Table 2.

[0016]

[Table 2]

実施例 2	容量維持率 (%)	容量回復率 (%)
ホリン酸アモニウム	90	98
ホクロロホスファイト	92	97
ホリン酸マグネシウム	90	98
ホリン酸ハリウム	90	98
ホリン酸亜鉛	90	98
ホリン酸ニッケル	90	98
ホリン酸アルミニウム	90	98
比較例 2	56	45

[0017] example of <<comparison 2>> -- the negative electrode which has not added the polyphosphate -- the negative-electrode board which applied the paste of a mixture was used, and also the cell was produced like the example 2, and the elevated-temperature retention test was performed The result is united and shown in Table 2. Table 2 -- a polyphosphate -- a negative electrode -- by the cell added to the mixture, the capacity maintenance factor and the capacity recovery factor were high, and it turns out that there is an effect which suppresses a capacity fall

[0018] <<example 3>> -- 100g of positive active materials obtained in the example 1 -- receiving -- the end of a carbon powder -- 10g, 8g of poly ethylene tetrafluoride, and a petroleum solvent -- adding -- further -- an ammonium polyphosphate -- adding -- agitating -- a positive electrode -- the paste of a mixture was obtained the positive electrode where the ammonium polyphosphate was obtained -- a mixture -- inside -- 2wt(s)% -- it came out comparatively, and it added so that it might contain And after applying this paste to the core material of titanium, it was made to dry, it rolled out and the positive-electrode board was obtained. The weight of the positive active material of the obtained positive-electrode board was 5g. The cell was produced like the example 1 using the obtained positive-electrode board, the negative-electrode board used in the example 1, and the nonaqueous electrolyte used in the example 2. moreover, the positive electrode which added poly chloro phosphite, an aluminum hydroxide, an antimony trioxide, antimony pentoxide, a magnesium hydroxide, boric-acid zinc, a zirconium oxide, or metaboric acid barium instead of the ammonium polyphosphate, respectively -- the positive-electrode board which applied the paste of a mixture was used, and also the cell was completely produced similarly The elevated-temperature retention test was performed on the obtained cell like the example 1. The result is shown in Table 3.

[0019]

[Table 3]

実施例 3	容量維持率 (%)	容量回復率 (%)
ホリン酸アモニウム	90	98
ホクロロホスファイト	92	97
水酸化アルミニウム	93	97
三酸化アリン	92	97
五酸化アリン	90	97
水酸化マグネシウム	92	98
ホリン酸亜鉛	94	98
酸化ホリウム	90	98
メタホリン酸ハリウム	92	98
比較例 3	56	45

[0020] example of <<comparison 3>> -- the positive electrode which has not added the ammonium polyphosphate etc. -- the positive-electrode board which applied the paste of a mixture was used, and also the cell was produced like the example 3, and the elevated-temperature retention test was performed The result is united and shown in Table 3. Table 3 -- an ammonium polyphosphate etc. -- a negative electrode -- by the cell added to the mixture, the capacity maintenance factor and the capacity recovery factor were high, and it turns out that there is an effect which suppresses a capacity fall

[0021] <<example 4>> It mixed by specific volumes [dimethoxyethane / ethylene carbonate, dimethoxyethane, etc. / which dissolved the one mol /l. / lithium perchlorate], and tricresyl phosphate was further added as phosphoric ester, it fully mixed, and nonaqueous electrolyte was obtained. In nonaqueous electrolyte, tricresyl phosphate was changed so that it might contain at a 0.05 - 30wt% rate, and it was added. The nonaqueous electrolyte obtained as mentioned above was used, and also the cell was produced like the example 1, and the elevated-temperature retention test was performed. The result is shown in Table 4.

[0022]

[Table 4]

トリクレシルホスフェート添加量 (wt%)	容量 維持率(%)	容量 回復率(%)
0.05	50	60
0.1	85	90
1.0	90	95
5.0	90	98
10.0	92	98
20.0	90	90
30.0	65	90

[0023] As mentioned above, it turns out that the addition of the antimony trioxide to nonaqueous electrolyte has [the thing of the range of 0.1 - 20wt%] high capacity maintenance factor and capacity recovery factor.

[0024] <<example 5>> -- the petroleum solvent after mixing styrene-butadiene-rubber 5g, adding an ammonium polyphosphate to 100g and fully mixing further to it in the end of a carbon powder it used in the example 1 -- adding -- enough -- agitating -- a negative electrode -- the paste of a mixture was obtained an ammonium polyphosphate -- a negative electrode -- a mixture -- to inside, it was made to change to the range of 0.05 - 30wt%, and added this negative electrode -- after applying the paste of a mixture to a copper core material, at 120 degrees C, it was made to dry, it rolled out and cut, and the negative-electrode board was obtained The weight of the carbon contained in a negative-electrode board was 1.5g. The obtained negative-electrode board was used, and also the cell was produced like the example 2, and the elevated-temperature retention test was performed. The result is shown in Table 5.

[0025]

[Table 5]

ホリン酸アンモニウム添加量 (wt%)	容量 維持率(%)	容量 回復率(%)
0.05	60	65
0.1	80	85
1.0	85	95
5.0	90	98
10.0	92	98
20.0	90	90
30.0	50	90

[0026] moreover, a negative electrode -- what added poly chloro phosphite was used instead of adding an ammonium polyphosphate to a mixture, and also the cell was produced similarly, and the elevated-temperature retention test was performed The result is shown in Table 6.

[0027]

[Table 6]

ポリクロロスファイト添加量 (wt%)	容量 維持率(%)	容量 回復率(%)
0.05	56	60
0.1	85	85
1.0	90	95
5.0	90	98
10.0	92	98
20.0	90	95
30.0	50	90

[0028] Table 5 and Table 6 -- an ammonium polyphosphate and poly chloro phosphite -- a negative electrode -- the thing of the range of 0.1 - 20wt% was excellent in the addition to a mixture for the capacity maintenance factor and the capacity recovery factor

[0029] <<example 6>> To 100g of positive active materials used in the example 1, 10g and 8g of poly ethylene tetrafluoride were added for the end of a carbon powder, and further, the antimony trioxide was added and it fully mixed. this positive electrode -- the petroleum solvent was added to the mixture, and it agitated enough, and considered as the paste an antimony trioxide -- a positive electrode -- a mixture -- it was made to change in 0.05 - 30wt% to inside, and mixed to it the obtained positive electrode -- after applying the paste of a mixture to the core material of titanium, it was made to dry, it rolled out and cut and the positive-electrode board was obtained The weight of the positive active material of the obtained positive-electrode board was 5g. The obtained positive-electrode board was used, and also the cell was produced like the example 3, and the elevated-temperature retention test was performed. The result is shown in Table 7.

[0030]

[Table 7]

三酸化アンチモン 添加量 (wt%)	容量 維持率(%)	容量 回復率(%)
0.05	60	65
0.1	80	85
1.0	85	95
5.0	90	98
10.0	92	98
20.0	90	90
30.0	50	90

[0031] as mentioned above, a positive electrode -- it turns out that the addition of the antimony trioxide to a mixture has [the thing of the range of 0.1 - 20wt%] high capacity maintenance factor and capacity recovery factor

[0032]

[Effect of the Invention] As mentioned above, the nonaqueous electrolyte rechargeable battery by this invention is high-energy density, it excels in the elevated-temperature preservation property, and the industrial meaning is large.

[Translation done.]